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What Every Business Student Needs to Know About Information Systems

Blake Ives
University of Houston, blake.ives@uh.edu

Joseph S. Valacich
Washington State University, jsv@wsu.edu

Richard T. Watson
Terry College of Business University of Georgia, rwatson@uga.edu

Robert W. Zmud
University of Oklahoma, rzmud@ou.edu

MARYAM ALAVI
Goizueta Business School, Maryam_Alavi@bus.emory.edu

See next page for additional authors

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Authors
Blake Ives, Joseph S. Valacich, Richard T. Watson, Robert W. Zmud, MARYAM ALAVI, RICHARD BASKERVILLE, JACK J. BAROUDI, CYNTHIA BEATH, THOMAS CLARK, ERIC K. CLEMONS, GORDON DAVIS, FRED DAVIS, ALAN R. DENNIS, OMAR A. EL SAWY Marshall School of Business University of Southern California, JANE FEDOROWICZ, ROBERT D. GALLIERS, JOEY GEORGE, Paul Gray, RUDY HIRSCHHEIM, SIRKKA JARVENPAA, LEN JESSUP, Chris F. Kemerer, JOHN L. KING, BENN KONSYNSKI, KEN KRAEMER, Jerry N. Luftman, SALVATORE T. MARCH, M. L. MARKUS, RICHARD O. MASON, F. W. MCFARLAN, EPHRAIM R. MCLEAN, LORNE OLFMAN, MARGRETHE H. OLSON, JOHN ROCKART, V. SAMBAMURTHY, PETER TODD, Michael Vitale, RON WEBER, and ANDREW B. WHINSTON

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WHAT EVERY BUSINESS STUDENT NEEDS TO KNOW ABOUT INFORMATION SYSTEMS

Blake Ives, Joe Valacich, Richard T. Watson, Robert Zmud, Maryam Alavi, Richard Baskerville, Jack J Baroudi, Cynthia Beath, Thomas Clark, Eric K. Clemons, Gordon B. Davis, Fred Davis, Alan R. Dennis, Omar A. El Sawy, Jane Fedorowicz, Robert D. Galliers, Joey George, Michael Ginzberg, Paul Gray, Rudy Hirschheim, Sirkka Jarvenpaa, Len Jessup, Chris F. Kemerer, John L. King, Benn Konsynski, Ken Kraemer, Jerry N. Luftman, Salvatore T. March, M. Lynne Markus, Richard O. Mason, F. Warren McFarlan, Ephraim R. McLean, Lorne Olfman, Margrethe H. Olson, John Rockart, V. Sambamurthy, Peter Todd, Michael Vitale, Ron Weber, Andrew B. Whinston

ABSTRACT

Whether Information Systems should or should not be part of the core business school curriculum is a recurring discussion in many universities. In this article, a task force of 40 prominent information systems scholars address the issue. They conclude that information systems is absolutely an essential body of knowledge for business school students to acquire as well as a key element of the business school's long-run strategic positioning within the university. Originally prepared in response to draft accreditation guidelines prepared by AACSB International, the article includes a compilation of the concepts that the authors believe to be the core information systems knowledge that all business school students should be familiar with.
Keywords: IS Knowledge, Business Students, AACSB

I. INTRODUCTION

This article was originally motivated by the unanimous conclusion of the Council of the Association for Information Systems (AIS) that a draft version of the AACSB Accreditation Standards document [AACSB International, September 2002], did not, in its undergraduate and graduate curricular guidelines, reflect the essential and growing role of information systems and technology in the future careers of business school graduates. We assume this omission at least partially stems from the failure of the information systems academic community to communicate effectively what comprises the core knowledge of information systems and why exposure to this core knowledge is essential for every business school student. At the request of the AIS Council, a group of 40 distinguished members of faculty were assembled to communicate this common body of knowledge to AACSB International. Because this subject is of importance to the members

of the Association for Information Systems, we are also publishing it in *Communications of the Association for Information Systems* for the benefit of the membership.

II. THE ROLE OF INFORMATION SYSTEMS IN MODERN ORGANIZATIONS

The earliest introduction of information systems into organizations came in the form of card processing machines typically housed in accounting departments and focused on historical information reporting. In the late 50's and early 60's those tabulating operations and others housed in some engineering groups were migrated to mainframe computers that were, in processing power, miniscule compared with today's desk top computers or even PDA's[1]. Over the ensuing decades, the transaction processing, management reporting, forecasting, and decision support enabled by information technology (IT) became essential to almost every aspect of the modern firm. Personal productivity tools similarly became essential tools for most business professionals. Most recently, information systems transcended departmental, divisional, and organizational boundaries in order to link the firm electronically, often instantaneously, to its customers, suppliers, and distribution partners. Wal-Mart, for example, used its sophisticated computer systems to bring a major competitor to its knees, as founder Sam Walton described:

"During that period in the late seventies when Kmart's management had such a strong resistance to any kind of change, that resistance included investment in systems. At the same time, our fellows were absolutely convinced that computers were essential to managing growth and keeping down our cost structure"[Walton & Huey, 1993].

The Wal-Mart experience was repeated in industry after industry. General Electric, Frito-Lay, Dell, Charles Schwab, American Airlines, Lands' End, Capital One, FedEx, Cisco, UPS, Amazon.Com represent just a few, though highly visible, examples of firms that harvested the benefits of investments in tightly integrated IT infrastructures, new electronic distribution channels, heightened business event visibility, greater operating efficiency, new information-based products, etc. Joining Kmart on the losing side of this equation, are firms such as the Encyclopedia Britannica, FoxMyer Drug Co., or Compaq Computers that saw their franchise seriously eroded or destroyed by failing to come to grips with information technology management. A key element in the successful firms is a systemic view of the organization and the role of information technology in managing the system as a whole.

It is commonly accepted[2] that we are now in the fifth wave of structural change in capitalism. The first wave focused on agriculture, water, and iron; the second on railways, steam, and mechanization; the third on steel, engineering, and electricity; and the fourth on oil, automobiles, motors, and mass produced goods. This fifth wave is named the digital or knowledge economy. In the fifth wave, preparation in information technology is essential, as noted by Freeman and Louca [2001],

> *"It would be irresponsible for a business school to graduate anyone without this fundamental preparation. Furthermore, we can anticipate an increasing need for executives who will create and manage knowledge and information systems in organizations and skills and technologies necessary to make them effective."*

The size of the investment in information technology and the impact of that investment on productivity demonstrate the necessity for information systems to be seen as a core knowledge domain within the business school curricula. IT constitutes the majority component of capital investment. In the fourth quarter of 2001 in the U.S.[3], for example, total investment in all equipment and software accounted for $1.005 trillion. Of this amount $289.2 billion was invested in computers and peripheral equipment, $191.3 billion in software, and $94.6 in communication equipment. (Not included in these numbers are, for instance, expenses for communication or other IT-related

services.) These investments in IT contrast with the $146.7 and $171.8 billion invested in industrial and transportation equipment, respectively. Capital spending on IT Equipment and software grew at a 20% annual rate from 1995 through the end of 2000, though the growth rate declined (–10.1%) in 2001 [Henry & Dalton, 2002]. Investments in IT clearly constitute a major driver of the U.S. as well as other major economies.

The impact of this investment on productivity is another key indicator of the importance of managing IT effectively. Productivity grew at a pace of only 1.4% per year from 1973 to 1995 (down from 2.8% per year for the previous 25 years), despite major investments in IT during much of this period. Since 1995, however, productivity grew at a 2.4% annual rate. Even in the current recession, productivity growth (1.9%) far exceeds expectations. Importantly, the current recession is the first of nine since 1950 when productivity growth did not turn negative. Macroeconomic studies appear to demonstrate that much of the recent step-up in productivity is attributed to information technology [Price & McKittrick, 2002]. One indicator is an 8.4% drop, from 1989 to 1998, in clerical jobs, among the most easily displaced by information technology, while total employment rose 15.3% [Price & McKittrick, 2002]. A second indicator is the difference in productivity growth rates between information intensive and non-information intensive industries. Between 1989 and 2000, productivity for the former group grew by 2.95% while productivity for the latter group grew only .58% per year [Dumagen & Gill, 2002]. While macro-economic and cross-industry studies now clearly demonstrate the positive impact of, and critical roles played by IT in the US economy, capturing those same benefits for a particular firm requires highly focused management attention and expertise.

While processing power, storage capacity, and bandwidth all continue to at least double every 18 months[4] for at least the next fifteen years, there is no end in site for the information revolution. Advances in networking, particularly wireless, will further fuel IT-driven innovation. The introduction of passive Radio Frequency ID technology (i.e., e-tags or smart labels[5]) raises the reality of making every physical object involved in the creation of products/services capable of some degree of intelligence, with implications that far transcend elimination of scanners at the grocery store (e.g., smart refrigerators, smart warehouses, self-healing machinery). We are also just at the initial stages of mass customization, a complex IT-enabled strategy that links customer, retailer, and manufacturer electronically to produce, in a timely manner, products personalized to customer desires or requirements. And, down the road we already see the emergence of optical computing, biological computing, and quantum computing[6] – any or all of which will fuel entirely new computing architectures and still more exciting applications. IT innovation will most likely continue to drive business innovation and growth in the next two decades and beyond.

However, this facilitating role of IT in enhancing business productivity and innovation is not the only reason why business students require focused education in IS. Computer security issues are growing in importance as we become, as a society, increasingly dependent on the Internet and other electronic infrastructures. Identity theft, denial-of-service attacks, spoofing, and warchalking[7] are just a few examples of increasingly common computer and network security threats. With the growth of integrated networks, personal privacy also becomes increasingly under threat and the issue of access to networks more socially divisive. Still, balanced against these downsides are the huge benefits to consumers from convenience, personalized service, and mass customization. It is essential that today's and tomorrow's managers recognize and act on both the opportunities and liabilities associated with IT. Moreover, responding to these opportunities and liabilities will provide interesting new strategic possibilities for existing and emerging businesses.

III. DEMAND FOR IS SKILLED PROFESSIONALS

Our primary emphasis in this document is on the core skills we believe are required of all business school graduates. However we feel that we cannot completely ignore the demand for graduates with IT specialties,[8] particularly because of the recent abnormal spike in demand for IT skills. The last five years of the twentieth century produced an unusual flare in demand for professionals skilled in information systems. Annual growth in IT services jobs in the U.S. was approximately 3%

in 1993 but rose to about 12% per year by 1999. In 1992 less than 2 million people in the U.S. were employed in IS services. By 2000 the number was over 3.5 million [Cooke, 2002]. Increases in jobs were accompanied by impressive gains in income for IT workers. In 1992 IT workers earned $41,800 compared with $25,400 for the U.S. population. By 2000, IT workers salaries of $73,800 were double the $35,000 received by the general U.S. population [Cooke, 2002]. The fuel for much of this revving up of the economic engine came from the transition to client-server architectures, the Year 2000 crisis, the widespread adoption of enterprise requirements planning (ERP) systems and the Dot.Com craze. Demand for IT majors during this period skyrocketed well beyond normal growth rates. At some business schools, IT became the biggest or second biggest major by the year 2000.

But the client server and ERP architectures are now largely in place, Y2K passed, and by the summer of 2000, the Dot.Com bubble burst[9]. In 2001 the job loss reported in the Dot.Com industry was over 100,000 and nearly a half million more in telecommunications [Challenger, Gray & Christmas, 2001]. Since then, demand for our undergraduate IT majors fell to perhaps half of what it was two years ago but is still at the level one would have predicted had the Dot.Com anomaly never occurred. All indications are that demand for IT professionals will return to a steady growth rate, initially driven by the emergence of wireless technology and ubiquitous computing. The need for firms to manage information by no means diminished.

We believe it would be a great mistake to view the popping of the Dot.Com bubble as foreshadowing the decline in future use of information technology by the world's businesses or a long term drop in demand for professionals with information systems skills. Rather, this anomaly offered a remarkable, if very capital inefficient, research and development opportunity, the benefits of which will largely be harvested after economic recovery and, in many cases, not by the start-up firms and their venture capitalists that fueled and funded the innovations.

IV. WHAT ALL BUSINESS STUDENTS NEED TO KNOW

We recognize that, at least in a few business schools, Information Systems is largely viewed as a "tools" course – one in which students might gain such knowledge as spreadsheets, presentation software, and project management tools. While information systems faculty are usually willing to provide tools expertise, particularly to undergraduates, we do not view this responsibility as central to our mission and see it only tangentially related to the strategic role that information systems play in organizations today. We also recognize that information technology is now pervasive throughout the business school curriculum and that many faculty feel very comfortable discussing IT applications and introducing tools in their respective disciplines. This development is natural since the conduct of all business functions was dramatically transformed by IT, and business schools' curricula must reflect business realities. We welcome and encourage this inevitable and promising evolution. We strongly believe, however, that there is a distinct and essential expertise about information systems use, development, integration, and management that will not be learned through tangential exposure in other disciplinary-specific courses; in other words, that which is everyone's responsibility becomes no ones responsibility. In Table 1 we capture the "core concepts" that are essential for a well-rounded business school graduate.

V. RECOMMENDATIONS

We very much appreciate AACSB International's desire to encourage schools of business to specialize in particular areas. We also recognize that there are ways to introduce core concepts into a curriculum that do not involve disciplinary-focused course structures. While applauding AACSB International for introducing this rich flexibility, we still strongly believe that the accreditation standard must better and more specifically reflect the essential role that IT plays, and will continue to play, in business organizations. We fear that failure to recognize the essential importance of information technology and systems might eventually lead to the migration of information technology expertise and education out of the business school, leaving business graduates with inadequate education in a major change lever while failing to ensure that a large

Table 1. Core Information Systems Requirements for all Business School Graduates

Key Information Systems Concepts	Learning Objectives (Examples). Business school graduates should be able to:
What are information systems?	• Explain the nature and interaction of technology, people, and organizational components • Distinguish between data, information and knowledge • View the organization as an information processing system designed to manage environmental uncertainty • Introduce elements of systems thinking - boundary, environment, scope, hierarchical decomposition, decoupling, etc
How do information systems influence organizational competitiveness?	• Discuss the use of IS for automation, integration, organizational learning, reengineering, and strategy • Understand the need to align IT investments with strategic plans • Understand how IT can be used to achieve and sustain competitive advantage • Discuss how IS can both constrain and enable organizations.
Why have databases become so important to modern organizations?	• Understand the nature, importance of, and uses for an integrated database • Understand the concept of, and means to ensure, data integrity • Describe database management systems and how they work • Explain the value of data warehousing and data mining concepts
Why are technology infrastructures so important to modern organizations?	• Explain the nature of, and organizational dependence on, technology and business platforms • Explain concepts of interoperability and scalability as well as the role of standards • Compare open versus proprietary architectures • Understand the problems in justifying investments in infrastructure • Recognize total cost of ownership for technology investments, e.g., desk top computing
What is the role of the Internet and networking technology in modern organizations?	• Discuss networking concepts, components, capabilities, and trends • Distinguish among internets, intranets, extranets • Describe the evolution of e-business and how e-business is transforming organizations and markets • Explain organizational implications of the pervasiveness of the Internet • Describe the development and impact of wireless networks and ubiquitous computing
What are the unique economics of information and information systems?	• Understand the economic characteristics of the information economy • Understand the cost structure of information systems and technology • Describe unique features of information economics – network effects, versioning and pricing of information products, lock-in, positive feedback, tipping points, and so on
How do information systems enable organizational processes?	• Explain the importance of enterprise-wide business processes and associated IS roles • Explain the importance of extra-enterprise processes, e.g., supply chain and CRM, and associated IS roles • Describe the various types of IS in support of operational, managerial and executive-level processes.
How do organizations develop, acquire and implement information systems?	• Understand how to manage complex, technology-based projects • Understand the difficulties in designing and building IS well as the strength and weaknesses of alternative development

	processes • Understand the trade-offs involved in developing software in-house, using a domestic or offshore provider, and buying off-the-shelf packages • Understand how to formulate and assess a Request-for-Proposal • Understand the difficulties in implementing IS and in leveraging the full potential of installed IS
What is the nature of IS management?	• Discuss the evolving and current roles of enterprise IS management • Explain the operating, managerial and strategic processes associated with IS management • Discuss advantages/disadvantages of alternative governance structures for IS management • Discuss IT sourcing and contractual and relationship management with third-party service providers • Consider the unique problems of managing IT in globally dispersed organizations
What ethical, criminal and security issues do organizations face when using information systems?	• Describe the ethical concerns associated with information privacy, accuracy, intellectual property, and accessibility • Introduce the nature (and increased potential of) computer crime • Explain what is meant by computer security and describe methods for providing computer security • Consider cross-border implications regarding privacy of data and integrity of Internet

number of technology professionals are adequately educated in basic business concepts. Such a migration would create two troublesome schisms.

- First, business practitioners would have problems communicating their needs to information technologists unfamiliar with the language and fundamentals of business.
- Second, a gap would be created between the market's demand for professionals and managers competent in the business of information technology (e.g., systems analysts, project managers, CIOs) and the supply.

Because every aspect of business is touched by information technology, all business school faculty have some responsibility to teach information systems concepts and effects (e.g., accounting information systems in accounting and e-commerce in marketing). Nevertheless, as was shown in Table 1, a core of information systems concepts and principles remains that all business graduates need. We believe that, in most cases, these concepts and principles are best delivered in an integrated and comprehensive course, though other approaches may be more appropriate, for example in a tightly integrated curriculum. No matter the approach, we recommend the inclusion of this core information technology content in the curriculum10.

VI. CONCLUSION

We believe that information technology is now the prime driver and enabler of business strategy for many, if not most, organizations. We also believe that the business school is the logical source for the managers who will guide this powerful economic engine. We strongly believe that from a long-term strategic perspective, it would be a serious mistake for the business school to allow this engine to continue to migrate into the hands of other schools, and as has already happened in numerous cases, in the same manner that a number of firms allowed information technology management to migrate into the hands of outsourcers. We strongly encourage the AACSB and business schools in general to build upon this opportunity.

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END NOTES

[1] Personal Digital Assistants such as the Palm, Treo, or Blackberry that provide electronic calendars, contact information, simple games, and, increasingly, access to wirelesss networks.

[2] The argument in this section is drawn from Freeman, Chris and Louca, Francisco [2001].

[3] For the sake of brevity we rely only on numbers drawn from U.S. government sources. We recognize these may provide an unrealistic estimate for the economies of other countries and do not reflect either the AACSB' or AIS' increasingly global orientation.

[4] While processing power doubles every 18 months, disk storage doubles every nine months and bandwidth every year. The later rates will probably accelerate; in the labs, scientists have already transmitted at rates of 10 trillion bits per second through a signle fiber optical fiber [Hecht, 2001].

[5] See http://www.howstuffworks.com/smart-label.htm for further information on smart labels.

[6] For short tutorial papers and further references on each of these technologies see: http://www.uhisrc.com/futuretech.htm.

[7] "Identity theft" involves using electronic or other means to masquerade, usually for financial gain, as another individual. "Denial-of-service attacks (DSA), refers to the practice of sending thousands or millions of electronic messages to a target computer with the intention of disrupting service. "Spoofing," which often accompanies DSA is sending an electronic message that is disguised so as to appear to have been from someone else. "Warchalking," is a scheme where by hackers travel around a metropolitan area looking for unprotected access to wireless networks; the name comes from the chalk marks they leave behind on buildings to inform others of the opportunity for illicit access.

[8] The Association for Information Systems has long been associated with development of curriculum for graduate and undergraduate IS programs. Curriculum guidelines are available from the AIS education web portal at: http://www.aisnet.org/Curriculum/ .

[9] While there was a considerable loss in market value attributable to the demise of Dot.Com's, the actual number of dot.com business failures may still be less than 10%." [U.S. Commerce Department 2002].

[10] The version of this article submitted to AACSB International included modifications to two proposed learning goals and the addition of a new learning goal. The proposed new goal was, "Systemic analysis and design of intra- and inter-organizational processes and their enabling infrastructures". At this writing we are not sure what action the AACSB will take on these proposals.

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AUTHOR AFFILIATIONS

BLAKE IVES
Professor
Charles T. Bauer Chair
Director, ISRC
University of Houston
bives@mac.com

JOE VALACICH
Marion E. Smith Chair; George & Carolyn Hubman Dist.Prof. in MIS
Washington State University
jsv@wsu.edu

RICHARD T. WATSON
Professor
J. Rex Fuqua Distinguished Chair
University of Georgia
rwatson@terry.uga.edu

ROBERT ZMUD
Professor
Michael F. Price Chair
University of Oklahoma
rzmud@ou.edu

MARYAM ALAVI
Professor
John and Lucy Cook Chair of Information Strategy
Senior Associate Dean
Goizueta Business School
Emory University
Maryam_Alavi@bus.emory.edu

JACK J BAROUDI
Professor and Associate Dean
College of Business and Economics
University of Delaware
baroudi@be.udel.edu

RICHARD BASKERVILLE
Professor
Georgia State University
Baskerville@acm.org

CYNTHIA BEATH
Professor
University of Texas at Austin
cbeath@mail.utexas.edu

THOMAS CLARK
Professor
Edward G. Schlieder Endowed Chair
Louisiana State University
tomclark@lsu.edu

ERIC K. CLEMONS
Professor
The Wharton School of the University of Pennsylvania
clemons@wharton.upenn.edu

GORDON DAVIS
Honeywell Professor
Carlson School of Management
University of Minnesota
gdavis@csom.umn.edu

FRED DAVIS
Professor
David Glass Chair
Department Chair
Walton College of Business
University of Arkansas
fdavis@walton.uark.edu

ALAN R. DENNIS
Distinguished Professor and John T. Chambers Chair of Internet Systems
Indiana University
ardennis@indiana.edu

OMAR A. EL SAWY
Director of Research, Center for Telecom Management (CTM)
Professor of Information Systems
Marshall School of Business
University of Southern California
omar.elsawy@marshall.usc.edu

F. WARREN MCFARLAN
Albert H. Gordon Professor of Business Administration
Harvard Business School
fmcfarlan@hbs.edu

EPHRAIM R. MCLEAN
Regents' Professor
George E. Smith Eminent Scholar's Chair
Robinson College of Business
Georgia State Unversity
emclean@gsu.edu

LORNE OLFMAN
Dean
School of Information Science
Claremont Graduate University
lorne.olfman@cgu.edu

MARGRETHE H. OLSON
Dean of Business and the McCallum Graduate School
Bentley College
molson@bentley.edu

JOHN ROCKART
Senior Lecturer Emeritus of Information Technology
Sloan School of Management
Mit
jrockart@mit.edu

V. SAMBAMURTHY
Eli Broad Professor of IT
The Eli Broad College of Business
Michigan State University
smurthy@msu.edu

PETER TODD
Associate Dean for Graduate Programs
Chesapeake and Potomac Professor of Commerce
McIntire School of Commerce
University of Virginia
pat4n@forbes2.comm.virginia.edu

MICHAEL VITALE
Professor
Australian Graduate School of Management
michaelv@agsm.edu.au

RON WEBER
Professor
University of Queensland
r.weber@commerce.uq.edu.au

ANDREW B. WHINSTON
Professor
University of Texas at Austin
abw@mail.utexas.edu

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